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Instream Flow Protection in Alaska, 2018–2019

by

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April 2020

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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by
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ABSTRACT

This report summarizes instream flow protection and related activities of the Alaska Department of Fish and Game (ADF&G), Instream Flow Program (IFP) during calendar years 2018 and 2019. The status of reservation of water (reservation) applications by other agencies and the public is also presented.

From 2018 to 2019, ADF&G filed 52 reservation applications for river reaches and was granted certificates of reservation for 4 river reaches, providing approximately 387 miles of fish habitat protection. Overall, ADF&G has filed reservation of water applications on 352 river reaches and 7 lakes. Certificates of reservation have been granted to ADF&G for 157 river reaches and one lake, and for one river and one lake under the water export provision. Factors that contributed to these achievements include ADF&G and Alaska Department of Natural Resources (DNR) leadership acknowledging the importance of fish habitat protection and making reservations a priority, the vision and framework provided by the 2002 DNR-ADF&G Memorandum of Understanding, and efficiencies gained by closer collaboration between agencies.

IFP staff performed 14 hydrologic investigations from 2018–2019. Investigations were performed primarily to obtain the necessary data to support reservation of water applications. IFP staff monitored 42 Federal Energy Regulatory Commission hydroelectric and hydrokinetic projects and served as ADF&G's representative for the Alaska Clean Waters Actions program, which funded 12 projects in state fiscal year 2018–2019.

Key words: instream flow, reservation of water, fish habitat protection, Alaska Water Use Act, Nushagak River Watershed Streamgage Network, Petersville Road Streamgage Network, Glenn Highway Streamgage Network, Chester Creek, Little Susitna River, Peterson Creek, Windfall Creek, Thorne River, Eva Creek, Freshwater Creek Streamgage Network, Federal Energy Regulatory Commission, hydroelectric, Alaska Clean Water Actions

INTRODUCTION

The State of Alaska has abundant and diverse sport fisheries that are of considerable recreational importance to anglers and others. To date, 19,898 water bodies in Alaska have been identified as supporting anadromous fish species (J. Johnson, Habitat Biologist, Alaska Department of Fish and Game, Anchorage, May 6, 2019, personal communication).

In 2018, an estimated 459,461 anglers fished 1,878,009 days and caught 2,503,124 fish in rivers and lakes throughout Alaska[1]. The continued production of these fishery resources depends, in part, upon sufficient amounts of good quality water to maintain seasonal fish habitat in rivers and lakes. Fish and other aquatic and terrestrial species have adapted to natural streamflows that provide essential seasonal habitats utilized by the various life stages of each species. Varying seasonal quantities of flowing waters and lake elevations are needed by fish using freshwater and estuarine habitats for migration, spawning, incubation, and rearing (Hynes 1970; Estes 1984; Hill et al. 1991; Poff et al. 1997; Bovee et al. 1998; Annear et al. 2004).

The Fish and Game Act requires the Alaska Department of Fish and Game (ADF&G) to "manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state" (AS 16.05.020). The act also enables ADF&G to use a variety of legal, regulatory, and administrative options to quantify and acquire water rights within lotic[2] and lentic[3] water bodies to sustain fish and wildlife resources (AS 16.05.050). Fish habitat permits (AS 16.05.841 and 16.05.871) issued by the ADF&G's Habitat Section are one of the tools that can be used to maintain sufficient amounts of water to

[1] Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, Alaska: Alaska Department of Fish and Game, Division of Sport Fish, cited February 12, 2020. Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/.

[2] Lotic refers to flowing waters such as rivers and streams.

[3] Lentic refers to still waters such as lakes and ponds.

protect fish habitat in lotic and lentic fish-bearing systems. For decisions that have the potential to impact a fish-bearing water body, ADF&G and the Alaska Department of Natural Resources (DNR) have agreed to coordinate water right and fish habitat permits to ensure permit conditions are consistent.[4]

In 1980, Alaska's water law was amended to allow protection of instream flows in rivers and water levels in lakes, commonly referred to as Alaska's instream flow law. Alaska's water law treats the term *instream flow* more broadly than most states' jurisdictions because the term may be used to refer to the rate or volume of flow in a river, the volume of water in a lake, or a related physical attribute such as water depth for identified resources and values. Water rights to retain water in lentic and lotic habitats can be acquired from DNR by a state or federal government agency or the public for one or a combination of four purposes:

1. protection of fish and wildlife habitat, migration, and propagation;
2. recreation and park use;
3. navigation and transportation; and
4. sanitation and water quality.

Alaska's water law follows the prior appropriation doctrine, which assigns seniority of water rights in the order they are filed (Alaska Constitution, Article VIII, Section 13). Under Alaska's water law, an appropriation to retain water within a water body for any of these purposes may also be defined as a reservation of water (reservation, AS 46.15.145). The term reservation is often used to differentiate between retaining water within lotic or lentic water body versus out-of-stream withdrawals. It is important to note that passage of the instream flow law expanded the meaning of appropriation in Alaska to represent all water right uses, including retention of water in lotic and lentic water bodies. However, an appropriation is still more commonly associated with out-of-stream and diversionary uses/water rights. Further information related to Alaska's instream flow law can be found in Curran and Dwight (1979), White (1982), Anderson (1991), Harle and Estes (1993), Spence (1995), and Burkardt (2000).

ADF&G created an Instream Flow Program (IFP) within the Division of Sport Fish (SF) to acquire reservations of water in priority fish-bearing water bodies. Over time, duties were expanded to address other instream flow related issues such as hydroelectric project licensing under the Federal Energy Regulatory Commission (FERC) and representation in the Alaska Clean Water Actions (ACWA) program. IFP staff also developed the capacity to collect hydrologic data to support reservation applications. This report summarizes ADF&G's Instream Flow Program activities from 2018 to 2019.

RESERVATIONS OF WATER

To file for a reservation of water, an application must be completed, signed, and submitted to DNR with the appropriate application fee. Applications are prepared to comply with requirements established by state law (AS 46.15.145), state regulations (11 AAC 93.141–147), reservation of water application form instructions, and the *State of Alaska Instream Flow Handbook* (DNR 1985), when applicable. An applicant can apply for a reservation to secure their interest and obtain a priority date, and they will then have three years to collect any additional data; a 2-year extension

[4] Memorandum from F. Rue, ADF&G Director of Habitat Division to G. Gustafon, DNR Director of Division of Land and Water Management, August 10, 1989; reaffirmed by ADF&G and DNR on December 16, 2009.

can be obtained with approval from DNR (11 AAC 93.142 (4)). The following is an overview of the reservation process followed by ADF&G.

Candidate Sites for Reservations

In the past, ADF&G had relied upon nomination work plans (Klein 2011). ADF&G has exhausted most of the useful information contained within these work plans. More recently, selection of candidate sites was primarily based on the amount of existing hydrologic records and the importance of a water body to fishery resources. Secondary considerations included the likelihood for competing out-of-stream uses and the availability of other mechanisms[5] to provide instream flow protection.

Data Compilation, Collection, and Analysis

A reservation application needs to include information that substantiates the amount of streamflow or level of water being requested for the selected purpose(s). Applications prepared by ADF&G included biological and hydrologic data to support requested streamflows. ADF&G collected and analyzed data according to accepted scientific methods and procedures that would meet evidentiary standards and any challenges[6] that may be filed.

Biological Data

A variety of sources were used to obtain information needed to document fish use in the selected water body. This information typically included fish distribution and periodicity[7] data that were summarized from ADF&G biologists, scientific literature, and the ADF&G Anadromous Waters Catalog.[8]

Hydrologic Data

DNR recommends a minimum of five years of continuous streamflow or lake level data to support water rights decisions, including reservation applications (Gary Prokosch, Chief Water Resources Section, DNR, April 26, 2005, personal communication). This five-year recommendation is intended to reduce potential bias that may be associated with intra- and interannual hydrologic variability.

When available, streamflow data describing seasonal and long-term hydrologic characteristics and quantifying instream flow needs were obtained from the U.S. Geological Survey (USGS) website. When hydrologic data were limited or not available, IFP staff collected streamflow data in accordance with USGS standards (Rantz et al. 1982; Klein 2013). Streamflow records were computed using the Water Information System Kisters Incorporated (WISKI) hydrologic data management software after they were proofed for errors and transformed into a WISKI-compliant format. WISKI is a Windows-based professional time series hydrologic management system that meets USGS standards for data computation. Where less than five years of data were available, simple linear regression was used to extend the streamflow record if a suitable, long-term

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[5] Other mechanisms may include fish habitat permits, water right permits, Clean Water Act permits (Section 401 Water Quality Certification, Section 402 National Pollution Discharge Elimination System, and Section 404 Dredge and Fill permits), Federal Power Act, and permits from land management agencies.

[6] Challenges may be filed by an aggrieved party to contest the validity of the data set, analyses, and rationale for the requested amount of water the department considers necessary.

[7] Seasonal use of habitat by species and life stage for passage, spawning, incubation, and rearing.

[8] See https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home.

streamgage was available (Klein 2013). Streamflow records were analyzed using SAS statistical software.

Instream Flow Analysis

Under Alaska law, applicants are not required to use a specific method for quantifying instream flow needs (11 AAC 93.142; DNR 1985). The burden is on the applicant to choose and defend the approach used.

ADF&G used hydrologic-based approaches combined with fish use information to quantify instream flow needs for fish. These included analyses based on historic streamflow data (Annear et al. 2004) and a variation of the Tennant Method (Tennant 1976; Estes 1998) to account for local hydrologic and biological conditions. ADF&G recommended streamflow regimes similar to the magnitude and timing of the natural streamflows to maintain seasonal use of fish habitat.

Hydrologic characteristics of a river were used as the primary basis to delineate reaches. This information came from various sources, including USGS topographic maps, ADF&G Anadromous Waters Catalog[8], ADF&G Freshwater Fish Inventory[9], and USGS National Hydrography Database[10]. Reach boundaries were selected to minimize differences in streamflow; major tributaries upstream and downstream of the streamgage site were generally selected as reach boundaries.

Adjudication

Adjudication is the legal process of determining the validity and amount of a water right and includes the settlement of conflicting claims among competing appropriators of record (11 AAC 93.970(1)). During the adjudication, DNR provides a 15-day public notice of the proposed reservation. If no further administrative actions are needed after all public comments are reviewed, DNR prepares a "Findings of Facts, Conclusions of Law and Decision" document that describes the information and rationale used for the decision and will issue a Certificate of Reservation. The certificate is recorded in the State Recorder's Office and includes a description of the water right, any conditions placed on it, and the priority date that establishes the seniority of the water right. An appeal may be filed to the DNR Commissioner, with an option to seek further remedy through Alaska's court system.

In 2002, a Memorandum of Understanding was signed between DNR and ADF&G to address the increasing backlog of reservation applications needing adjudication and to improve the overall process. As part of the agreement, ADF&G partially funds a position at DNR to adjudicate applications. This position also provides assistance with preparing applications and other instream flow related needs. DNR and ADF&G meet annually to prepare a work plan that prioritizes applications to adjudicate in the coming year and to discuss instream flow related issues.

[9] See http://www.adfg.alaska.gov/index.cfm?adfg=ffinventory.main

[10] See http://nhd.usgs.gov/data.html

ACTIVITIES

RESERVATIONS OF WATER

From 2018 to 2019, ADF&G filed 52 reservation applications on river reaches (Table 2; Figures 1 and 2). ADF&G also received 4 certificates of reservation which provided instream flow protection for approximately 387 river miles of fish habitat (Table 3; Figure 3).

HYDROLOGIC INVESTIGATIONS

Hydrologic investigations were performed on 14 projects by IFP staff from 2018 to 2019. The primary objective was to obtain sufficient data to support reservations of water applications. Investigations are summarized below and shown in Figures 5 and 6.

Nushagak River Watershed Streamgage Network

The Nushagak River watershed is located in Southwest Alaska. The hub community for the region is Dillingham, located at the mouth of the Nushagak River. Tributaries that flow into the Nushagak River near the village of Ekwok (upstream from Dillingham between river mile 50 and 120) were selected for this hydrologic investigation (Figure 5). To collect the hydrologic data necessary for reservation applications, a streamgaging network was established across seven sub-watersheds that flow into the Nushagak River (Klein 2013).

For this project, the index streamgage was established by USGS on the mainstem of the Kokwok River (USGS #15302812) in October 2016. In addition, nine discharge measurement (DM) stations were also established: unnamed tributary to the Kokwok River, mainstem Iowithla River and adjacent unnamed tributary, mainstem Napotoli Creek and adjacent unnamed tributary, Klutuk and Lower Klutuk Creeks, Koklong Creek, and Koggiling Creek. Streamflows in these tributaries are expected to correlate with the index streamgage installed on the Kokwok River.

The index streamgage has operated for three full water-years and it is anticipated to continue operation through September 2021. During this time discharge measurements are being collected concurrently at five DM stations operated by USGS and four DM stations operated by ADF&G. From January 2018 to December 2019, six site visits were made to each ADF&G DM station (Klutuk, Lower Klutuk, Koklong, and Koggiling Creeks) to collect discharge measurements.

Collectively, these four creeks provide approximately 130 miles of anadromous waters and support populations of Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), chum (*O. keta*), and pink (*O. gorbuscha*) salmon, as well as Arctic char (*Salvelinus alpinus*).

IFP staff conducted two educational outreach visits to schools in the Nushagak River watershed. In October 2018, staff visited the New Stuyahok Chief Ivan Blunka School and engaged students in educational activities focused on hydrology and aquatic ecology. In October 2019, staff conducted an educational outreach visit to the Koliganek School, demonstrating how to perform a stream discharge measurement, sampling macroinvertebrates from the river substrate, and exploring salmon biology with the students by examining the similarities and differences between Alaska's five Pacific salmon species.

Petersville Road Streamgage Network

The Susitna River watershed is located approximately 25 miles northwest of Anchorage across Cook Inlet in Southcentral Alaska. For this hydrologic investigation, tributaries that are accessible

via Petersville Road on the west side of the Susitna River watershed were selected. An index streamgage has been operated by USGS on Kroto Creek (USGS #15294080) since May 2017. ADF&G measures streamflow at 11 DM stations on tributaries to the Susitna River: Martin Creek, Peters Creek, Kenny Creek, Twentymile Creek, upper Kroto Creek, Seventeenmile Creek, Gate Creek, East Fork Ninemile Creek, West Fork Ninemile Creek, Cottonwood Creek, and Whistling Lake tributary/Twin Creek (Figure 5). Collectively, the 11 creeks selected for DM stations provide approximately 200 miles of anadromous waters which support populations of Chinook, coho, sockeye, chum, and pink salmon.

During the 2018 and 2019 field seasons, ADF&G collected five to six instantaneous discharge measurements at each DM station. Streamflows in this area are expected to correlate with the nearby streamgage installed on Kroto Creek. Data collection will continue for this project until 10 to 20 discharge measurements, covering a range of streamflows at each of the DM stations, have been recorded.

Glenn Highway Streamgage Network

The Matanuska River watershed is located approximately 50 miles northeast of Anchorage in Southcentral Alaska (Figure 5). A streamgage has been continuously operated by the USGS since September 21, 2007, on Moose Creek (USGS #15283700), a tributary to the Matanuska River. In early 2017, two DM stations were established by ADF&G on nearby tributaries to the Matanuska River that were expected to correlate with the Moose Creek streamgage: Granite Creek and Kings River. These two tributaries provide approximately 20 miles of anadromous waters that support populations of Chinook, coho, and chum salmon.

In 2018, ADF&G collected instantaneous discharge measurements on three site visits to both sites to conclude data collection. The discharge data at both sites correlated strongly with the USGS streamgage on Moose Creek and synthetic periods of record were calculated for both sites to complete reservations of water applications. The application for Kings River was submitted to DNR in 2019, and the application for Granite Creek will be submitted in 2020.

Little Susitna River near Houston

The Little Susitna River is located approximately 30 miles north of Anchorage in the Matanuska Valley (Figure 5). The river has approximately 90 miles of anadromous waters and supports populations of Chinook, coho, pink, chum, and sockeye salmon; rainbow trout (*O. mykiss*); Dolly Varden (*Salvelinus alpinus*); and Arctic grayling (*Thymallus arcticus*).

The Little Susitna River drains out of the Talkeetna Mountains and flows about 100 miles from its headwaters to its outlet in Upper Cook Inlet. The watershed has a drainage area of approximately 350 mi^2. DNR has issued instream flow reservations to ADF&G for the middle and upper portions of the river; these reservations cover 40 miles from the upstream limit of anadromous use down to the Parks Highway bridge.

ADF&G installed streamgage #14901 on the Little Susitna River at the Parks Highway bridge in 2017. This streamgage will continue to operate until July 1, 2021. Site visits were made to the streamgage 10 times during 2018 and nine times during 2019 to download transducer data, take discharge measurements, survey the water surface elevation, and perform routine streamgage maintenance. It is anticipated that a reservation application for the lower portion of the river (downstream from the Parks Highway bridge) will be filed with DNR in 2021.

Lower Kenai Peninsula Streamgage Network

Stariski Creek and Anchor River are located near Anchor Point on lower Kenai Peninsula, approximately 15 miles north of Homer (Figure 5). Stariski Creek flows approximately 25 miles from its headwaters in the Caribou Hills to its mouth in Cook Inlet with a 50 mi^2 watershed of primarily lowlands. The Anchor River flows over 45 miles from the Caribou Hills to Cook Inlet; it has a watershed of approximately 225 mi^2 composed of both lowlands and more rugged terrain with elevations over 2000 ft.

In 2011, ADF&G filed a reservation of water application on Stariski Creek; however, this application was lacking some hydrologic data for the winter months. To fill this data gap, ADF&G streamgage #11601 was re-established on Stariski Creek in July 2018. This streamgage will continue to operate until the summer of 2020 and serve as an index streamgage for additional DM stations. Site visits were made to the streamgage five times during 2018 and seven times during 2019 to download transducer data, take discharge measurements, and perform routine streamgage maintenance. The data collected will allow for the adjudication of the previously filed application.

In addition to the streamgage, ADF&G established six DM stations in the lower Kenai Peninsula area: Stariski Creek at Sergeant Avenue (8.5 miles upstream from the streamgage), Two Moose Creek, Anchor River, two locations on the North Fork Anchor River, and an unnamed tributary to Chakok River. These water bodies provide habitat for Chinook, coho, sockeye, chum, and pink salmon. Collectively, discharge measurements at these locations could lead to instream flow reservations on up to 64 miles of river and stream habitat.

During both the 2018 and 2019 field season, ADF&G collected four to five discharge measurements at each DM station. Data collection will continue until a minimum of ten measurements are collected at each location. It is anticipated reservation of water applications will be filed for these sites in 2020 or 2021.

Chester Creek near Anchorage

Chester Creek flows roughly 10 miles from its headwaters in the Chugach Mountains through the city of Anchorage to its mouth into Knik arm of Cook Inlet (Figure 5). The Chester Creek watershed drains over 30 mi^2. The majority of the creek is anadromous, with the lower reaches supporting coho, pink, and sockeye salmon, as well as Dolly Varden. The upper reach, which is the focus of this investigation, supports mainly coho and sockeye salmon.

From September 1980 to October 1984, the USGS operated a streamgage (#15274798) on upper Chester Creek. To collect the additional streamflow data needed to support a reservation application, ADF&G installed a streamgage (#15001) in 2017 on upper Chester Creek near the same location as the previous USGS streamgage. Nine site visits were made to the streamgage in 2018 to download transducer data, take discharge measurements, and perform routine streamgage maintenance. Data collection concluded in September 2018 and streamflow records are under development. A reservation application for Chester Creek will be submitted in 2020.

Quartz Creek Streamgage Network

The Quartz Creek watershed is located near Cooper Landing on the central Kenai Peninsula and lies within the boundaries of Chugach National Forest (Figure 5). The watershed drains an area of approximately 50 mi^2 and contains over 23 miles of anadromous fish habitat. The Quartz Creek drainage, which is part of the Kenai River watershed, provides productive spawning and rearing habitat for Pacific salmon and is a popular sport fishing destination for fly fishermen. Additionally,

Tern Lake, a marshy lake in the watershed that is located at the intersection of two main highways, offers excellent nature viewing opportunities that attracts tourists and locals.

Notable fish species in this watershed include Chinook, coho, sockeye, chum, and pink salmon, as well as rainbow trout, Dolly Varden, and whitefish (*Coregonus sp.*). The U.S. Fish & Wildlife Service operated a weir near the mouth of Quartz Creek during the years 2013–2015 (Gates and Boersma 2014a, 2014b, 2016). The weir was only operational during a 2- to 3-month period in the early summer, as the primary goal was enumerating Chinook salmon from the early-run Kenai River population. During those three years combined, a total of 1,053 Chinook salmon, 111,458 sockeye salmon, 536 pink salmon, 217 coho salmon, 6 chum salmon, 19,327 Dolly Varden, 1,074 rainbow trout, 22 Arctic grayling, and 362 round whitefish (*Prosopium cylindraceum*) passed by the weir.

During the summer of 2018, ADF&G established the Quartz Creek Streamgage Network consisting of two index streamgages and six DM stations. The streamgages are located on Quartz Creek (ADF&G #15301) and at the outlet of Tern Lake, which flows into Daves Creek (ADF&G #15201). There are two additional DM stations on Quartz Creek and four stations are located on tributaries to Quartz Creek (Johns Creek, Summit Creek, Dry Creek, and an unnamed tributary).

Since the establishment of the streamgage network, ADF&G completed 16 site visits to the Tern Lake/Daves Creek streamgage and 14 visits to the Quartz Creek streamgage to download transducer data, take discharge measurements, and perform routine streamgage maintenance. An additional 30 discharge measurements were performed between the six DM stations. Spawning salmon were observed at two previously undocumented locations and have been nominated to the Anadromous Waters Catalog. The two streamgages will continue to operate until October 2023.

Aniak River Streamgage Network

In 2019, a hydrologic investigation was initiated on the Aniak River with funding support from the Alaska Sustainable Salmon Fund. The Aniak River watershed is located near the city of Aniak in the Yukon-Kuskokwim Delta, approximately 100 miles northeast of Bethel (Figure 5). The Aniak River flows north approximately 95 miles from its headwaters draining the Kilbuck and Kuskokwim Mountains through lowlands and tundra to its mouth at the confluence with the Kuskokwim River, one mile upstream from the community of Aniak. The Aniak River watershed supports all five species of Pacific salmon and resident species including rainbow trout, Dolly Varden, northern pike (*Esox Lucius*), Arctic grayling, burbot (*Lota lota*), sheefish (*Stenodus leucichthys*), lake trout (*Salvelinus namaycush*), whitefish (*Coregonus sp.*), longnose suckers (*Catostomus Catostomus*), blackfish (*Dallia pectoralis*), and slimy sculpin (*Cottus cognatus;* Lafferty and Bingham 2002).

IFP staff installed an index streamgage on the Aniak River (#15801) in June 2019 and conducted three additional site visits during the open water season. In addition to the streamgage, five DM stations have been established on tributaries to the Aniak River: Doestock River, Buckstock River, Salmon River, Kipchuk River, and Upper Aniak River. The primary DM stations are the Doestock and Buckstock Rivers; additional DM stations will be visited if time and resources allow. Data collection for this project is anticipated to continue through September 2024. The project will protect over 100 miles of fish habitat.

Southwest Prince William Sound Streamgage Network

In 2019, ADF&G partnered with the United States Forest Service (USFS) for a hydrologic investigation on the Chugach National Forest in southwestern Prince William Sound, funded through the Exxon Valdez Oil Spill Trustee Council. The study area is approximately 40 miles south of the community of Whittier and spans multiple watersheds: Eshamy Lake and Creek, Gumboat Lakes and Gumboot Creek, Jackpot Lakes and Creek, and Shrode Lake and Creek (Figure 5).

Eshamy Creek drains Eshamy Lake and flows approximately 0.4 miles from the outlet of Eshamy Lake to the mouth at Eshamy Lagoon. Eshamy Lake has a large return of sockeye salmon, in addition to a variety of other fish species, which is unusual for PWS because the majority of water bodies in PWS are short, steep streams that primarily support pink salmon populations. The entirety of Eshamy Creek is anadromous and provides habitat for sockeye, coho, and pink salmon; cutthroat trout (*O. clarkii*); and Dolly Varden.

Gumboot Creek drains a chain of four lakes, each named Gumboat Lake. Gumboot Creek flows approximately 0.2 miles from the outlet of the lowest Gumboat Lake to the mouth at Eshamy Lagoon and provides habitat for of sockeye, coho and pink salmon; cutthroat trout; and Dolly Varden.

Jackpot Creek drains a series of seven lakes connected by small cascading falls. Jackpot Creek flows approximately 0.4 miles from the outlet of the lowest lake to the mouth at Jackpot Bay and provides habitat for Chinook, sockeye, coho, chum and pink salmon; and Dolly Varden.

Shrode Creek drains Shrode Lake flowing approximately 0.8 miles from the outlet of Shrode Lake to the mouth at Long Bay and provides habitat for sockeye, coho, chum, and pink salmon; cutthroat trout; and Dolly Varden.

An index streamgage operated by the USGS was established at Eshamy Lake and Creek (#15237030) and DM stations were established by ADF&G and USFS on Shrode Creek, Gumboat Creek, and Jackpot Creek along with a lake measurement station on Shrode Lake. During the 2019 field season, ADF&G and USFS made three site visits to Shrode Lake to download data, maintain the lake gage, and collect discharge measurements. One site visit was made to Jackpot and Gumboot Creeks to collect discharge measurements.

Due to complications with funding, it is unclear whether work on this project will continue.

Windfall Creek near Juneau

Windfall Creek is located 18 miles northwest of Juneau (Figure 6). Windfall Creek drains out of Windfall Lake and flows 0.5 miles into a side channel of the Herbert River. The entire watershed is located within the Tongass National Forest. The creek, downstream of Windfall Lake, has approximately 0.5 miles of anadromous waters and supports populations of coho, pink, chum, and sockeye salmon; steelhead and cutthroat trout; and Dolly Varden char. It is a popular fishery for Juneau-area anglers and is the only Juneau-area stream where anglers can catch and harvest sockeye. There is a USFS public use cabin located on the northeast shore of the lake that can be accessed by a 3.2-mile trail.

An ADF&G fish weir operated in the spring of 1997 and counted 616 cutthroat trout, 34,074 Dolly Varden char, and 9 out-migrating steelhead trout from Windfall Creek (Jones and Harding 1998). Immigrating sockeye salmon were counted at ADF&G fish weirs in 1989 and 1997, and the total

return was estimated to be 4,667 in 1989 and 4,228 in 1997 (Bethers and Glynn 1990; Yanusz 1998). ADF&G has also conducted foot surveys of spawning sockeye salmon in Slate Creek, a tributary to Windfall Creek above Windfall Lake, since 1990.

ADF&G installed streamgage #13801 at Windfall Lake on June 17, 2013. Site visits were made to the streamgage eight times during 2018 to download transducer data, take discharge measurements, and perform routine streamgage maintenance. This streamgage was in operation until October 1, 2018, and was decommissioned on June 14, 2019.

A reservation of water application, using two years of streamflow data, was filed with and accepted by DNR on September 2, 2015. An updated application will be submitted to DNR in 2020.

Davies Creek near Juneau

Davies Creek, a tributary to Cowee Creek, is located 40 miles northwest of Juneau in Southeast Alaska (Figure 6). From its headwaters, Cowee Creek flows northwest eight miles to Berners Bay. South Fork Cowee Creek and Davies Creek enter the mainstem from the south and north, respectively. Land ownership within the drainage is fragmented between USFS, state, private, and Goldbelt Native Corporation. The USFS manages 88% of the land within the watershed as the Heen Latinee Experimental Forest (HLEF; USFS 2009). The HLEF is located mostly in the upper portions of the watershed while the lower portion of the watershed is managed by the State of Alaska as Point Bridget State Park. A popular public use cabin named Cowee Meadow is located within the park and is accessible from the Glacier Highway by a 2.5-mile trail. Cowee and Davies Creeks support populations of coho, pink, and chum salmon; steelhead trout; cutthroat trout; and Dolly Varden char.

USGS operated a streamgage (Station #15054990) on Davies Creek for three years from October 1, 1969, to September 29, 1972. ADF&G staff installed a new streamgage (#11404) at Davies Creek on September 21, 2018, approximately 0.5 river miles upstream of the old USGS streamgage. The streamgage will operate until October 1, 2020, and collect an additional two years of streamflow data on Davies Creek. Discharge measurements are also being taken concurrently on Cowee Creek upstream of Davies Creek (DM station #11403).

The three years of streamflow data from the USGS gage, and two years of new data, will be combined to create a five-year period of record for Davies Creek. Ten discharge measurements have been taken concurrently at each station since the streamgage was installed in 2018. Following the completion of data collection in 2020, the streamflow data will be analyzed, and reservation applications will be filed with DNR.

Eva Creek near Sitka

Eva Creek near Sitka drains out of Lake Eva and flows approximately 0.7 river miles in an easterly direction before entering Hanus Bay (Figure 6). An inlet stream, also referred to as Eva Creek, enters on the west end of Lake Eva, and two smaller unnamed inlet tributaries enter the lake on the north side. The watershed has a drainage area of approximately 20 mi^2. A well-maintained trail on the south side of Eva Creek extends from Hanus Bay to the outlet of Eva Lake.

The Eva Creek watershed supports populations of coho, pink, chum, and sockeye salmon; steelhead; cutthroat trout; and Dolly Varden char. ADF&G operated a fish weir on Eva Creek in the springs and summers of 1963, 1964 and 1995. During the operation of the weir from April 14 to July 31, 1995, a total of 7,605 sockeye salmon, 117,821 Dolly Varden char, 2,535 cutthroat trout, 347 chum salmon, 173 pink salmon, 2 rainbow trout, and 17 steelhead trout were counted

(Yanusz 1996). ADF&G has also conducted pink salmon counts on Eva Creek using aerial and foot surveys.

Eva Creek, downstream of Lake Eva, has always been highly important to fish, wildlife, and people. Large migrations of sockeye, coho, and pink salmon have provided important subsistence harvests. Sportfishing within the Eva Creek watershed increased after the Eva Creek trail was constructed in 1924. Since 1980, approximately three floatplane flights per week drop off and pick up visitors at the Eva Lake USFS public use cabin. This cabin is rented nearly every day between June and October (Van Dyke 2003). In recent years, the Eva Creek watershed and trail have become a popular destination for passengers aboard small cruise ships. Hanus Bay provides a secure anchorage for the small cruise ships, while Eva Creek, Lake Eva, and the trail provide passengers ample opportunity to view spawning salmon, wildlife, and Southeast Alaska scenery. Approximately 2,000 people visit Eva Creek during the spring and summer months (Van Dyke 2003).

ADF&G has operated streamgage #13901 at the Lake Eva outlet since August 16, 2016. Site visits were made to the streamgage 12 times during 2018 and 2019 to download transducer data, take discharge measurements, and perform routine streamgage maintenance.

A DM station (#13902) was established on Eva Creek, just upstream of Eva Lake, in 2016. During 2018 and 2019, nine discharge measurements were collected at this station.

Streamgage #13901 and DM station #13902 will remain in operation until October 2021. A reservation of water application will be finalized at the completion of data collection, to protect 0.7 mile of Eva Creek from the mouth upstream to Lake Eva.

Freshwater Creek near Hoonah

Freshwater Creek, Kennel Creek, and Pavlof River are adjacent watersheds that are located in the northeast portion of Chichagof Island, within the coastal rainforest of Southeast Alaska. All three watersheds drain into Freshwater Bay, approximately 14 miles southeast of Hoonah, AK (Figure 6).

Freshwater Creek flows out of the mountains in a generally easterly direction for approximately 10 miles before emptying into Freshwater Bay. Freshwater Creek intercepts many tributaries along its route to saltwater, including the North Fork Freshwater Creek at river mile (RM) 1.2, and an unnamed tributary at RM 2.55. The mountains surrounding Freshwater Creek reach elevations of 2,000 to 3,200 feet above mean sea level. USFS Road 8508 out of Hoonah roughly parallels the upper reaches of the North Fork Freshwater Creek and crosses Freshwater Creek at RM 2.5. A system of other seasonally maintained roads provide access to the Freshwater Creek tributaries and nearby Kennel Creek and Pavlof River.

Freshwater Creek, Kennel Creek, and Pavlof River support populations of coho, pink, and chum salmon; cutthroat trout; and Dolly Varden char. In addition, Freshwater Creek supports a population of steelhead trout and Pavlof River supports a population of sockeye salmon. Combined, the three watersheds provide more than 37 river miles of anadromous fish habitat.

ADF&G has operated streamgage #14801 on Freshwater Creek since September 21, 2017. Site visits were made to the streamgage 12 times during 2018 and 2019 to download transducer data, take discharge measurements, and perform routine streamgage maintenance.

In 2017, DM stations were established on North Fork Freshwater Creek, Kennel Creek, Pavlof River, and on Freshwater Creek above Streamgage #14801. During 2018 and 2019, five to six discharge measurements were collected at each DM station.

Streamgage #14801 and all the DM stations will remain in operation until October 2022. Reservation of water applications will be finalized at the completion of data collection, to protect over nine miles of Freshwater Creek from the mouth upstream. If the correlation between Streamgage #14801 and the DM stations remain robust, reservation of water applications will be completed for the stream reaches with discharge stations.

Luck and Control Creeks on Prince of Wales Island

Luck Creek and Control Creek are part of the Central Prince of Wales (POW) Island Streamgage Network, in Southeast Alaska (Figure 6). Nearby communities include Coffman Cove to the northeast, Thorne Bay to the southeast, Klawock to the southwest, and Naukauti to the northwest.

Luck Creek flows approximately seven river miles in a northeasterly direction from its headwaters in the central POW mountains before emptying into Luck Lake. The outlet of Luck Lake is named Eagle Creek and flows 1.7 miles before emptying into Clarence Strait. Luck Creek, Luck Lake, and Eagle Creek support populations of coho, sockeye, chum, and pink salmon; cutthroat and steelhead trout; and Dolly Varden char. Most of the Luck Creek watershed is composed of high gradient terrain and mountain peaks exceeding elevations of 2,500 ft. Streamgage and DM stations within this watershed are located within medium floodplain channels with gravel and cobble substrate and bank full widths of approximately 40–100 ft.

Control Creek is 15 miles southwest of Luck Lake and flows approximately 3.5 river miles in a northeasterly direction out of Control Lake to its confluence with an unnamed tributary. Control Creek supports populations of coho salmon, sockeye salmon, and Dolly Varden char. Most of the Control Creek watershed is composed of low gradient muskegs, lakes, and ponds. The streamgage and DM stations within this watershed are located within medium floodplain channels with gravel and cobble substrate and a bank full width of approximately 100 feet. Control Creek offers angling opportunity as well as great recreational opportunity. A public use cabin is located upstream on Control Lake, and a campground and hiking trail system are located downstream on Balls Lake.

ADF&G installed streamgage #15401 on Luck Creek and streamgage #15701 on Control Creek on August 29, 2018. After installation, site visits were made to both streamgages nine times during 2018 and 2019 to download transducer data, take discharge measurements, and perform routine streamgage maintenance.

DM stations were also established in 2018 on the west fork of Luck Creek, Eagle Creek, Ratz Creek, and on Logjam Creek. During 2018 and 2019, three to five discharge measurements were collected at each DM station.

Streamgages #15401 and #15701 and all DM stations will remain in operation until October 2023. Reservation of water applications will be finalized at the completion of data collection to protect 4.5 miles of Luck Creek and 1.2 miles of Control Creek. If robust correlations are found between the streamgage and the discharge stations, applications will be completed for the stream reaches with DM stations.

FERC Hydroelectric Project Licensing

The Federal Energy Regulatory Commission (FERC) administers the Federal Power Act (FPA), which governs the regulation of hydroelectric projects in the United States, among other duties. FERC issues licenses that specify how projects will be constructed and operated, including any protection, mitigation, and enhancement requirements. FERC licenses specify how streamflows will be allocated between energy generation and other beneficial uses recognized by the FPA and other applicable laws (Roos-Collins and Gantenbein 2005). The FPA affords considerable weight and due deference to ADF&G as the state's fish and wildlife agency. If FERC does not accept all of ADF&G's recommendations, they must attempt to resolve any such inconsistency, giving due weight to the department's authority and expertise. Each project is unique, requiring reviews and analyses specific to affected resources.

Prior to 1998, ADF&G's review of FERC hydroelectric projects was handled on a regional basis. To provide better consistency and interdepartmental coordination, a position was created within the IFP to oversee statewide coordination efforts for all FERC jurisdictional projects and to ensure all legal and administrative requirements are timely met. Non-FERC hydroelectric projects are reviewed by ADF&G Habitat Section staff.

Under the FERC process, applicants obtain a preliminary permit that gives them the exclusive right to study the project's feasibility. ADF&G plays an important role in assisting the applicant to obtain fish and wildlife information needed for project review. If an applicant is interested in pursuing the project, a license application is submitted before the end of the Preliminary Permit term. From 2018 to 2019, IFP staff monitored 42 FERC hydroelectric and hydrokinetic projects (Table 4).

Alaska Clean Water Actions

Alaska contains more than 40% of the entire nation's surface water resources. The majority of these water bodies are considered pristine, although with over three million lakes and more than 12,000 rivers, it is impossible to assess them all. Still, Alaska is bound by national laws and policies, such as the Clean Water Act, and is required to assess and report on the status of the state's waters. To aid in this lofty endeavor, the Alaska Clean Water Actions (ACWA) program was created through Alaska Administrative Order 200 and brings together the three state resource agencies—Alaska Department of Environmental Conservation (DEC), ADF&G, and DNR—to characterize Alaska's waters in a holistic manner that includes the sharing of relevant data and expertise. Each agency is responsible for collecting and assessing water body information related to its expertise: ADF&G assesses aquatic habitat, DEC assesses water quality, and DNR assesses water quantity.

The ACWA team maintains an interagency database of water bodies throughout the state. Water bodies are ranked based on criteria that evaluate their current condition, environmental and developmental threats, and resource value. High-priority water bodies may be eligible for project funding through the annual ACWA grant solicitation process. Currently this ranking system is being updated to an ArcGIS-based Waterbody Prioritization Model, which should be completed by June 2020. This improved model will be more objective and holistic by incorporating many data layers of current water quality, water quantity, and aquatic habitat information.

The ACWA team evaluates grant proposals and awards funding to projects that restore, protect, or conserve water quality, water quantity, and aquatic habitat on prioritized waters. In the past,

ACWA grants have been awarded annually and spanned the state fiscal year (July to June). Beginning in 2018, the grant cycle has changed to a 2-year period, with grant funding being awarded in March for the following two years. This new grant cycle will better accommodate larger, more complex projects.

During the last grant cycle, ACWA awarded over $700,000 in grants to 12 projects throughout the state (Table 5). The grant period began March 2019 and will be completed in February 2021. Funding sources for ACWA grants included Environmental Protection Agency Clean Water Act Section 319 funding (nonpoint source management) and DEC Clean Vessels and Beaches Environmental Assessment and Coastal Health Act funding.

During the 2018 and 2019 personal use fishery on the Kenai River, ADF&G, in cooperation with DEC, Kenai Watershed Forum, and the ACWA program, established an information booth on Kenai's North Beach to help educate dipnetters about beach health and fishing regulations. The booth staff, who were mostly volunteers, provided information on proper disposal of fish waste, fishing regulations, fish identification, tides and weather, and up-to-date fish counts and commercial openers. In 2018, the booth operated on 12 days throughout the fishery (July 10–31), with an average of 31 visitor interactions per 4-hour shift. In 2019, the booth operated on 13 days, with an average of 37 visitor interactions per 4-hour shift. The information booth has been successful at engaging a wider audience of dipnetters, establishing an agency presence on the North Beach, and developing educational materials and signage.

DISCUSSION

RESERVATIONS

From 2018 to 2019, ADF&G filed 52 reservations and was granted 4 certificates, providing approximately 387 miles of fish habitat protection. To date, ADF&G has filed reservation applications on 352 river systems and 7 lakes. Certificates of reservation have been granted to ADF&G for 157 river reaches and 1 lake, and for one river and one lake under the water export provision[11] (Table 1). To date, ADF&G has protected 2,599 miles of streams and 1,481 surface acres of lakes. Factors that contributed to these achievements include ADF&G and DNR leadership acknowledging the importance of fish habitat protection and making reservations a priority, the vision and framework provided by the 2002 DNR-ADF&G Memorandum of Understanding, and efficiencies gained by closer collaboration between DNR and ADF&G staff.

Due to a lack of streamflow and lake data, a greater portion of staff time and resources is being allocated toward hydrologic data collection efforts in order to obtain the necessary data to file reservations. Operating a streamgage is typically a five-year commitment, unless there is already a short-term record and a suitable, concurrently operating USGS streamgage nearby that can be used to extend the hydrologic record. To optimize staff time and resources, IFP staff generally use a streamgaging network approach, whereby an index streamgage (either USGS or ADF&G) is identified or established and semi-permanent DM stations are established concurrently. In remote areas of the state, IFP staff rely on grants and cooperators to assist with projects, primarily due to the large financial commitment. These collaborations also provide the advantages of assistance

[11] Water exported out of one of the six defined hydrologic units requires a mandatory reservation to protect fish resources (AS 46.15.035).

with logistical issues, combination of resources, and achievement of mutually shared strategic priorities.

HYDROLOGIC DATA NEEDS

The primary purpose for the hydrological investigations is to obtain the necessary data to support reservation applications. Investigations were based out of ADF&G's Anchorage and Douglas offices.

The paucity of hydrologic data throughout most of Alaska limits ADF&G's ability to acquire reservations of water (Brabets 1996; Estes 1998). Although Alaska has approximately 40 percent of the nation's surface water outflow[12], only 489 USGS gaging stations have been established in Alaska (J. Conaway, USGS Hydrologist, Anchorage, October 3, 2019, personal communication). Of these, only 331 streamgages provided five or more years of historic records (Table 6).

In Water Years 2018 and 2019, USGS operated 100 and 106 gaging stations in Alaska, respectively (Table 6; J. Conaway, USGS Hydrologist, Anchorage, October 3, 2019, personal communication). This represents approximately one streamgage site per 5,500 mi^2, which contrasts significantly with the western United States where there is approximately one streamgage per 400 mi^2.

Baseline hydrologic data are needed by water resource agencies and water users for planning and management. Accurate estimates of available streamflows and lake elevations are needed for project designs, management of water rights, and environmental analyses. Obtaining these data can be difficult and expensive because of challenges that include Alaska's limited road systems, extreme weather conditions, and the loss of equipment to bears and other wildlife.

Without baseline hydrologic data, models must be used to estimate seasonal and long-term streamflow characteristics. On streams with limited or no streamflow data, using hydrologic models to predict long-term or seasonal flow characteristics is difficult and often produces estimates with high uncertainty. Furthermore, it is more time-consuming to estimate streamflow characteristics for streams with limited or no data than it is to summarize data for a stream with an adequate hydrologic record.

To address the need for streamflow and lake data, IFP staff use three approaches. First, more staff resources are dedicated to hydrologic investigations to collect the streamflow and lake data. Second, partnerships and funding opportunities are explored to leverage our resources and increase hydrologic data collection. Finally, annual funding for streamgaging efforts has been provided in the Division's budget. These funds are commonly leveraged with USGS to maximize the amount of streamflow data collected[13]. All together, these efforts have enabled IFP staff to meet program objectives and provide instream flow protection for Alaska's fish and wildlife resources.

FERC HYDROELECTRIC LICENSING ACTIVITIES

In 2019, FERC issued a Final Environmental Impact Statement (FEIS) and a project license for the Grant Lake Hydroelectric Project. Although both the project applicant and the resource agencies proposed post-operation monitoring of fish populations in Grant Creek, FERC ruled that

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[12] Alaska Department of Natural Resources: Water Resources Program. 2012. Alaska Hydrologic Survey: surface water. http://dnr.alaska.gov/mlw/water/hydro/components/surface-water.cfm (Accessed May 2012).

[13] Water bodies gaged include Indian River, Situk River, Chatanika River, Mulchatna River, Stuyahok River, Ophir Creek, Wasilla Creek, Montana Creek, Stariski Creek, Goldstream Creek, Little Willow Creek, Anchor River, Dangerous River, and Italio River.

no post-construction fish population monitoring was required. The reasons for FERC's decision was because, "The proposed fishery monitoring efforts [did] not provide direct benefits to the fishery, and it [was] not clear how the proposed fish monitoring would inform project-related matters" (FERC 2019). In the past, monitoring of fish populations after a hydropower project is operational has been an important part of verifying the effectiveness of environmental measures to protect fish. Monitoring allows ADF&G to fulfill the part of its mission to protect and maintain the fish resources of the state. With the decision in the FEIS for the Grant Lake Project, FERC appears to be setting a precedent that will limit the possibilities of fish population monitoring during the operational phase of hydropower projects.

RECOMMENDATIONS

More hydrologic information on seasonal and long-term streamflows is needed throughout Alaska. Ideally, more streamgages should be installed, but also new technologies should be explored such as models that use existing streamflow/environmental data, remote sensing techniques, or satellite imagery.

The relationship between instream flows and fish productivity needs to be more intensively researched. Ideally, investigations should be conducted over multiple life cycles and in areas not significantly influenced by human activities. Naturally occurring fish populations and the amount of available versus utilized habitat should be monitored to better understand fish habitat preferences. Research is needed on key environmental parameters (e.g., relation of upwelling/ downwelling to spawning fish, effects of water temperature variability on fish activity and development, and influence and effects of turbidity on aquatic organisms), and the interrelationship of environmental parameters to productivity.

Out-of-stream appropriations should be reviewed by DNR once every 10 years, similar to reservations of water. This would allow DNR to better manage Alaska's water resources and minimize or avoid water use conflicts.

Instream flow education, training, and outreach should be strengthened within the department and interested stakeholders. A fundamental goal commonly identified by instream flow practitioners is to achieve public recognition of the importance of maintaining instream flows and lake levels to sustain healthy fish populations. A key step toward achieving this goal is comprehensive outreach and incorporation of instream flow concepts and activities into education programs and school systems.

Dedicated funding to the ACWA grant pool is needed to continue to address stewardship of Alaska's water bodies. Information about aquatic habitat issues is also needed to improve the ACWA database. Information can range from fish habitat concerns to documented habitat degradation and can include field data, reports, or photographs.

The experience of other states has shown that it is prudent to protect instream flows as early as possible; otherwise, opportunities for protection can become more difficult, costly, and contentious.

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FIGURES AND TABLES

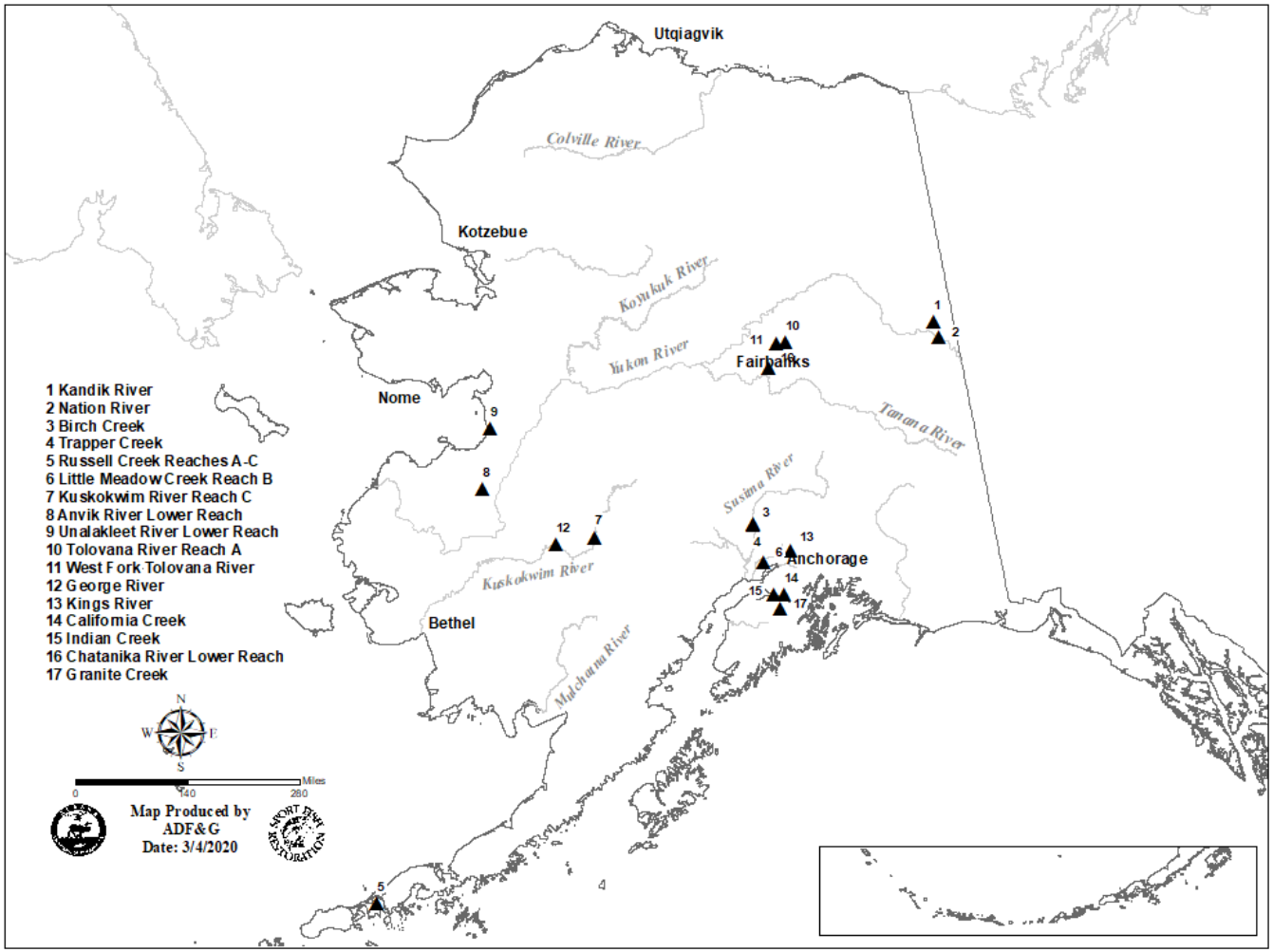

Figure 1.–Location of ADF&G reservation of water applications filed from 2018 to 2019 in Alaska, except Southeast.

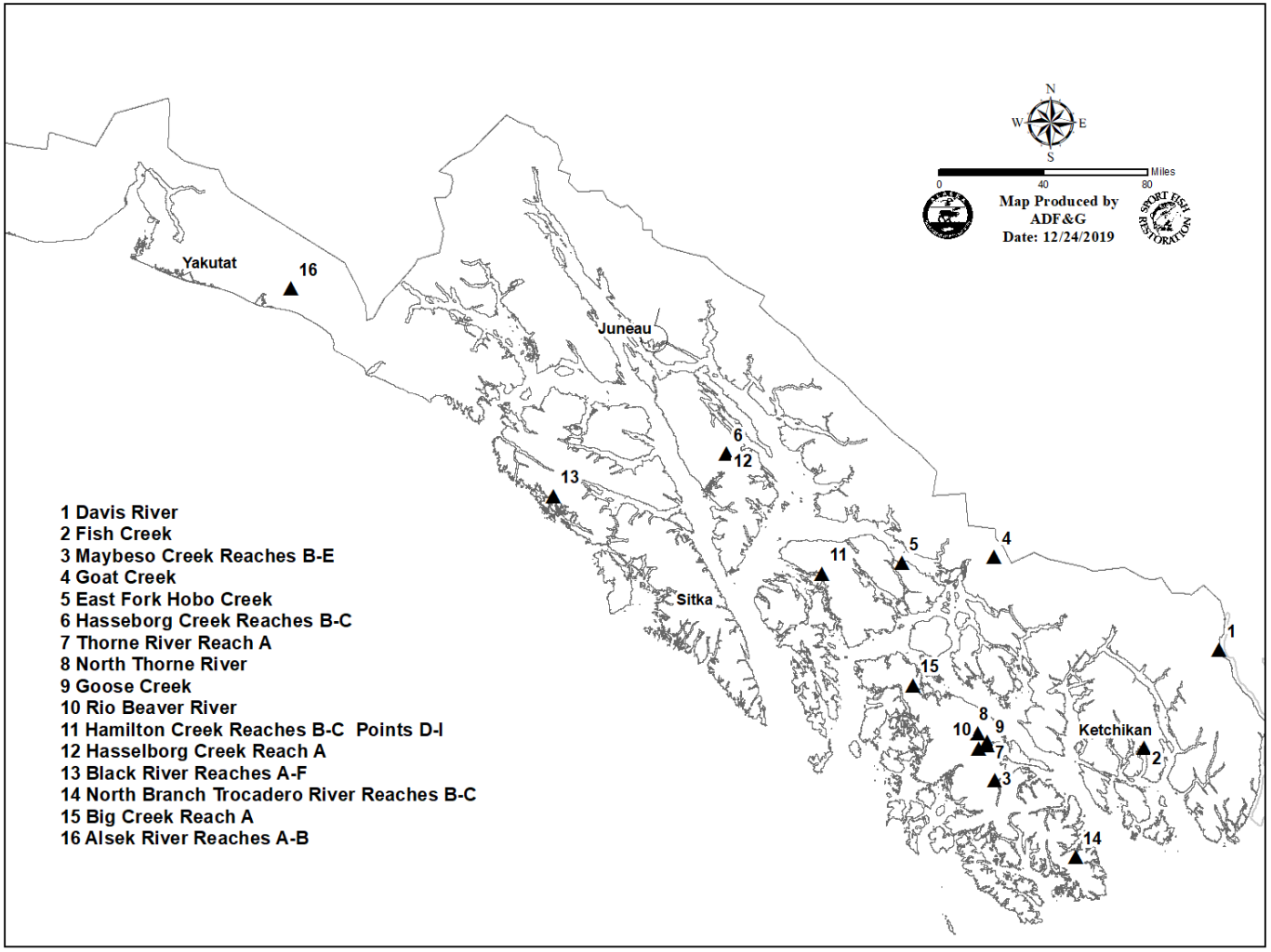

Figure 2.–Location of ADF&G reservation of water applications filed from 2018 to 2019 in Southeast Alaska.

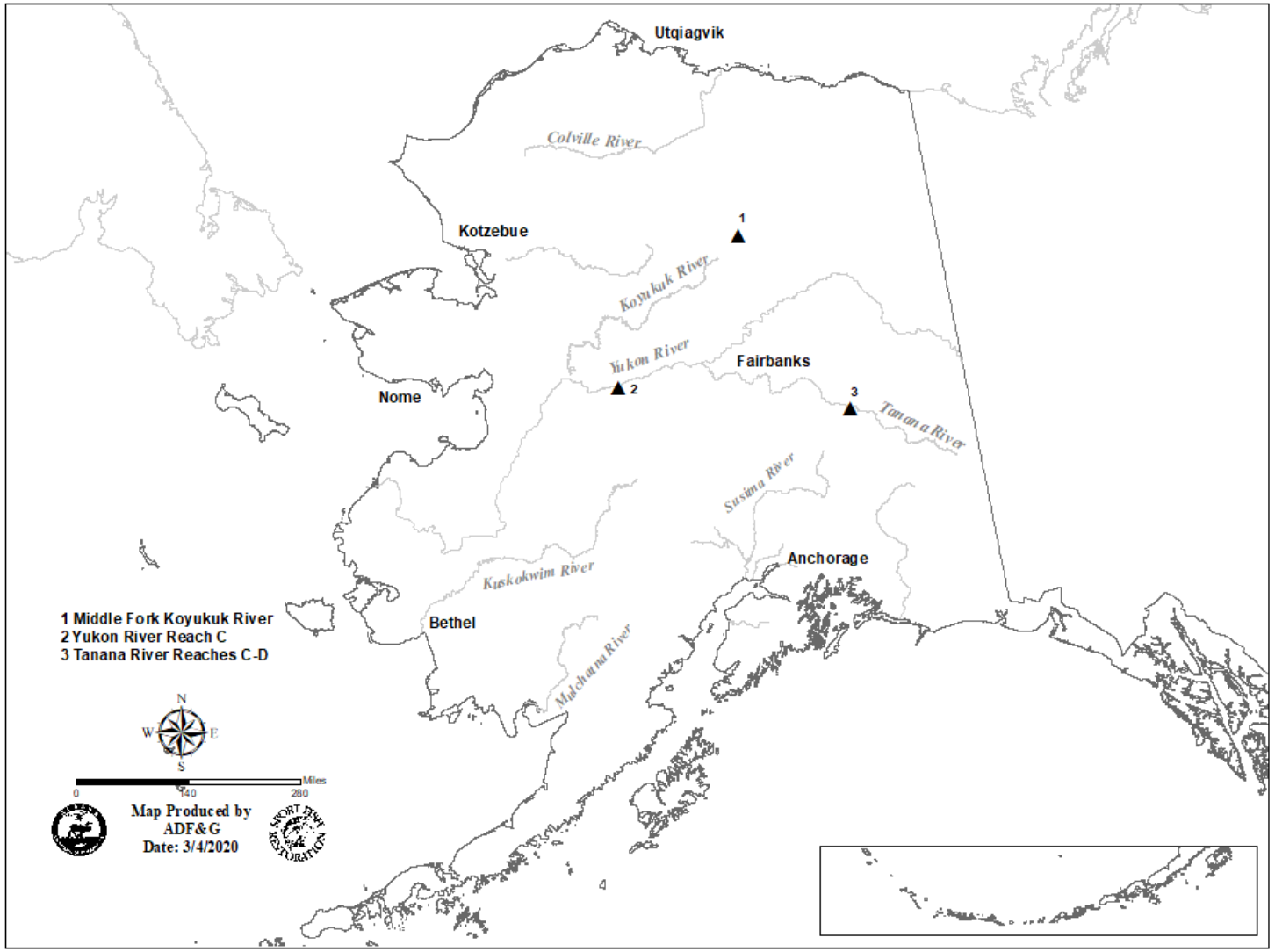

Figure 3.–Location of ADF&G certificates of reservation granted from 2018 to 2019 in Alaska.

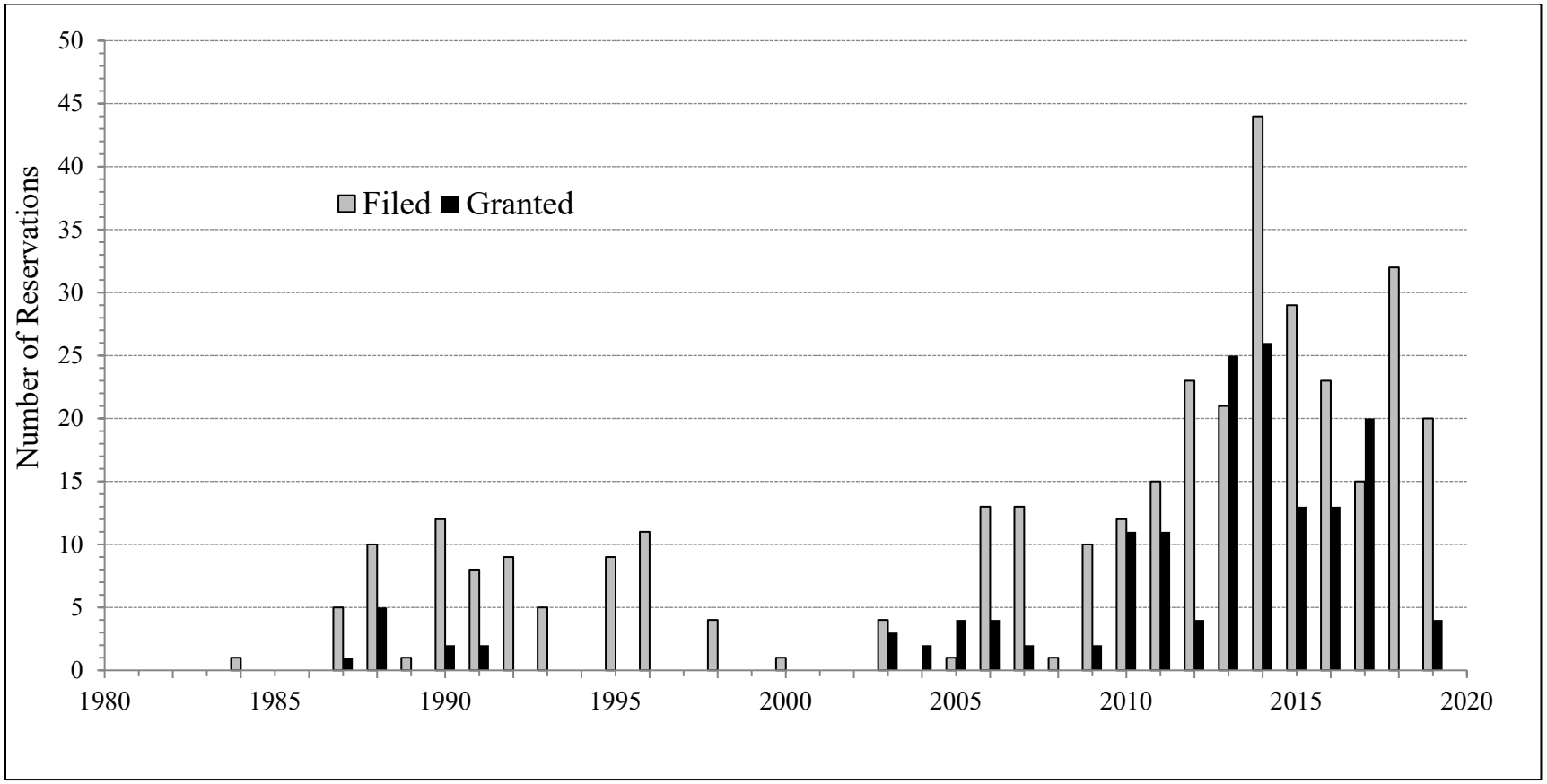

Figure 4.–Number of ADF&G reservations filed and granted from 1980 to 2019 in Alaska.

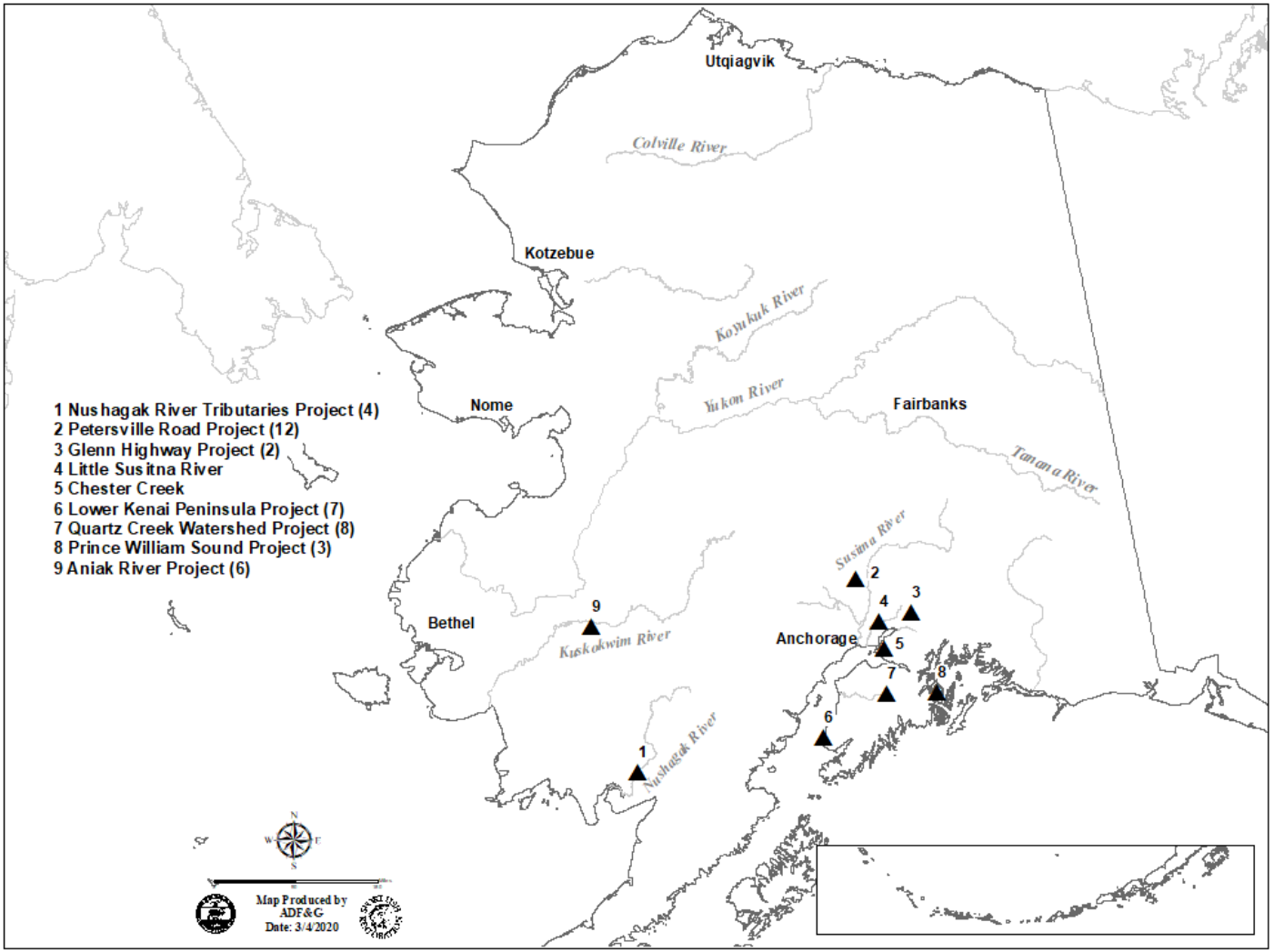

Figure 5.–Location of hydrologic investigations performed from 2018 to 2019 by ADF&G Instream Flow Program staff in Alaska, except Southeast. Parenthesis indicates the number of stations monitored.

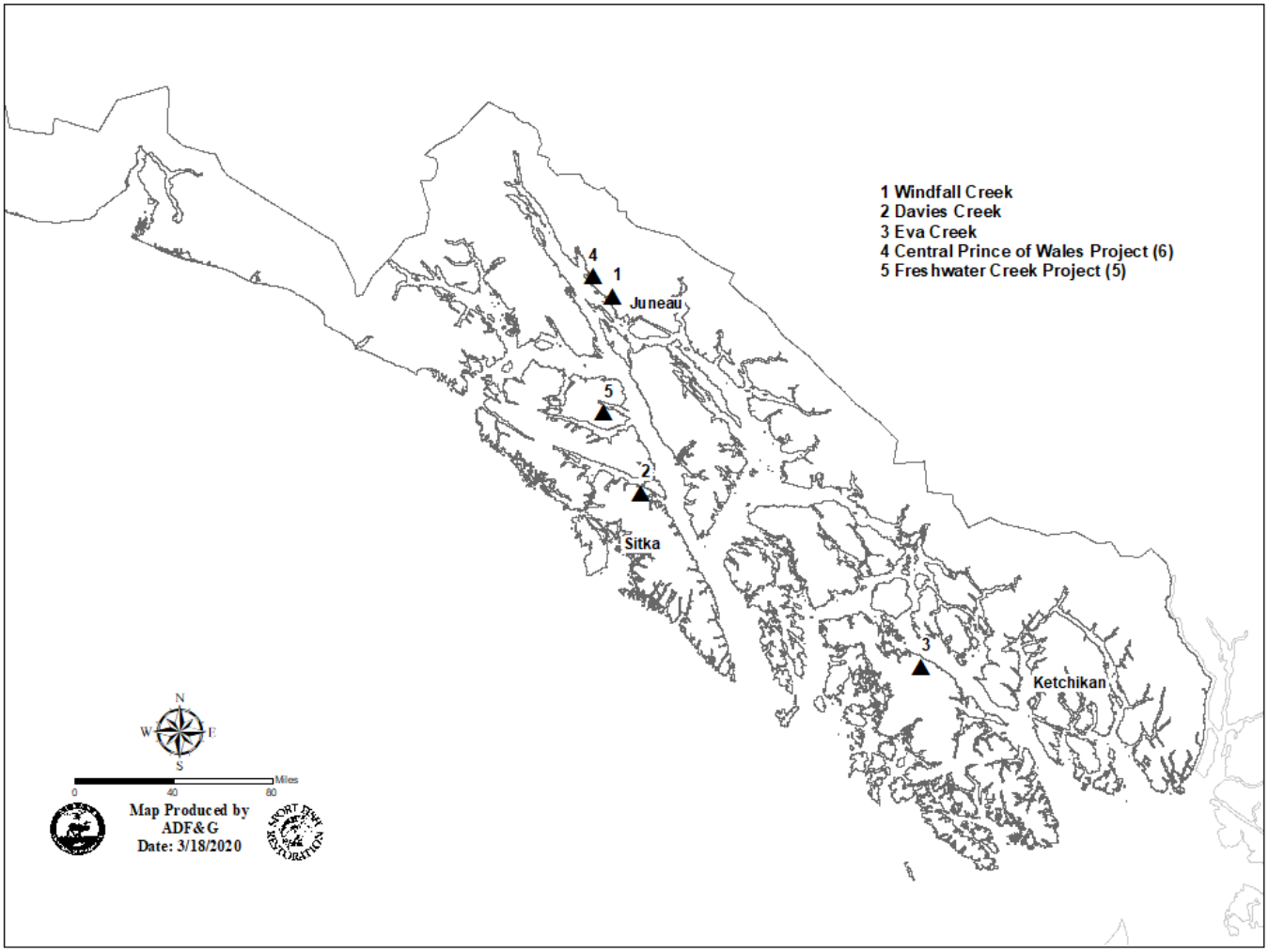

Figure 6.–Location of hydrologic investigations performed from 2018 to 2019 by ADF&G Instream Flow Program staff in Southeast Alaska. Parenthesis indicates the number of stations monitored.

Table 1.–Summary of all reservation of water applications filed and granted in Alaska as of December 2019.

Organization/Private Individual	Filed		Granted	
	Rivers	Lakes	Rivers	Lakes
ADF&G	352	7	157	1
U.S. Fish and Wildlife Service	61	140	1	–
Bureau of Land Management	22	–	1	–
Trout Unlimited	11	–	–	–
Curyung Tribal Council-Trout Unlimited	11	–	–	–
Chuitna Citizens Coalition	3	–	–	–
Eklutna Native Village	3	1	–	–
Southwest Alaska Salmon Habitat Partnership-ADF&G	3	–	–	–
The Nature Conservancy-ADF&G	1	–	–	–
Arctic Unit of the Alaska Chapter of the American Fisheries Society-ADF&G	1	–	–	–
Trout Unlimited-ADF&G	1	–	–	–
Cook Inletkeeper-ADF&G	1	–	–	–
Cheesh-na Tribal Council	1	–	–	–
Chickaloon Native Village	1	–	–	–
Bristol Bay Heritage Land Trust-New Koliganek Village Council	1	–	–	–
Willie Dixon	1	–	–	–
Kenai Watershed Forum	1	–	–	–
Copper River Watershed Council	–	1	–	–
ADF&G (per Water Export Provision[a])	–	–	1	1
DNR (per Water Export Provision)	–	–	2	2

Source: K. Sager, DNR Water Resources Section, January 22, 2019, personal communication.

[a] The Water Export Provision (AS 46.15.035) refers to water exported out of one of the six defined hydrologic units that require a mandatory reservation to protect fish resources.

Table 2.–Summary of ADF&G reservation of water applications filed from 2018 to 2019 in Alaska.

Name	DNR LAS No.[a]	Priority Date
Kandik River	32110	1/4/2018
Nation River	32111	1/4/2018
Birch Creek near Talkeetna	32114	1/4/2018
Trapper Creek near Talkeetna	32112	1/4/2018
Davis River near Hyder	32115	1/4/2018
Fish Creek near Ketchikan	32116	1/4/2018
Russell Creek Reach A	32141	1/24/2018
Russell Creek Reach B	32142	1/24/2018
Russell Creek Reach C	32143	1/24/2018
Little Meadow Creek Reach B	32175	2/14/2018
Maybeso Creek Reach B	32187	7/14/2009
Maybeso Creek Reach C	32190	7/14/2009
Maybeso Creek Reach D	32191	7/14/2009
Maybeso Creek Reach E	32192	7/14/2009
Goat Creek	32248	3/29/2018
East Fork Hobo Creek	32249	3/29/2018
Thorne River Reach A	32394	5/29/2018
North Thorne River	32395	5/29/2018
Goose Creek	32396	5/29/2018
Rio Beaver River	32397	5/29/2018
Kuskokwim River Reach C	32427	6/18/2018
Anvik River, Lower Reach	32482	7/13/2018
Unalakleet River, Lower Reach	32483	7/13/2018
Hamilton Creek Reach B	32640	4/12/2007
Hamilton Creek Reach C	32641	4/12/2007
Hamilton Creek Point D	32642	4/12/2007
Hamilton Creek Point E	32643	4/12/2007
Hamilton Creek Point F	32644	4/12/2007
Hamilton Creek Point G	32645	4/12/2007
Hamilton Creek Point H	32646	4/12/2007
Hamilton Creek Point I	32647	4/12/2007
Hasselborg Creek Reach A	32650	4/12/2007
Tolovana River Reach A	32662	1/15/2019
West Fork Tolovana River	32663	1/15/2019

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Name	DNR LAS No.[a]	Priority Date
George River	32664	1/15/2019
Kings River	32665	1/15/2019
California Creek near Girdwood	32666	1/15/2019
Indian Creek near Girdwood	32667	1/15/2019
Black River Reach B	32698	4/12/2007
Black River Reach C	32699	4/12/2007
Black River Reach D	32700	4/12/2007
Black River Reach E	32701	4/12/2007
Black River Reach F	32703	4/12/2007
Chatanika River Lower Reach	32737	3/21/2019
Perkins Creek Reach B	32798	6/1/2007
Perkins Creek Reach C	32799	6/1/2007
North Branch Trocadero River Reach B	32974	7/14/2009
North Branch Trocadero River Reach C	32975	7/14/2009
Big Creek Reach A	32990	8/2/2019
Granite Creek near Portage	33012	8/14/2019
Alsek River Reach A	33013	8/14/2019
Alsek River Reach B	33014	8/14/2019

Note: See Figures 2 and 3 for site locations.

[a] The Land Administration System (LAS) is managed by Alaska Department of Natural Resources (DNR) to provide case file summaries and abstracts of information depicted on the State Status Plat.

Table 3.–Summary of ADF&G Certificates of Reservation granted from 2018 to 2019 in Alaska.

Name	DNR LAS No.[a]	Priority Date	Granted Date	Miles of Fish Habitat Protected
Middle Fork Koyukuk River	30712	11/25/2015	3/21/2019	55
Yukon River Reach C	29870	8/15/2014	3/20/2019	240
Tanana River Reach C	29781	7/1/2014	5/21/2019	39
Tanana River Reach D	29782	7/1/2014	5/21/2019	53
			Total	387

Note: See figure 4 for site locations.

[a] The Land Administration System (LAS) is managed by Alaska Department of Natural Resources (DNR) to provide case file summaries and abstracts of information depicted on the State Status Plat.

Table 4.–Summary of FERC hydroelectric and hydrokinetic projects in Alaska monitored by ADF&G from 2018 to 2019.

Project	FERC No.	Capacity (kW)[a]	Status
Southeast			
Annex Creek	2307	3,600	Licensed Hydroelectric
Armstrong – Keta	8875	80	License Exemption
Beaver Falls	1922	7,100	Licensed Hydroelectric
Black Bear	10440	4,500	Licensed Hydroelectric
Blind Slough/Crystal Lake	201	2,000	Licensed Hydroelectric
Blue Lake	2230	16,900	Licensed Hydroelectric
Burnett River Hatchery	10773	80	Licensed Hydroelectric
Crooked Creek/Jim's Lake Elfin Cove	14514	160	Proposed Hydroelectric
Dewey Lakes	1051	943	Licensed Hydroelectric
Falls Creek	11659	800	Licensed Hydroelectric
Gartina Falls	14066	450	Licensed Hydroelectric
Goat Lake	11077	4,000	Licensed Hydroelectric
Green Lake	2818	18,540	Licensed Hydroelectric
Hidden Falls	14785	330	Conduit Exemption
Jetty Lake	3017	249	Licensed Hydroelectric
Kasidaya	11588	3,000	Licensed Hydroelectric
Ketchikan Lakes	420	4,200	Licensed Hydroelectric
Lake Dorothy	12379	14,300	Licensed Hydroelectric
Mahoney Lake	11393	9,600	Under FERC Stay
Pelican	10198	700	Licensed Hydroelectric
Hiilangaay (Reynolds Creek)	11480	5,000	Licensed Hydroelectric
Salmon Creek	2307	6,700	Licensed Hydroelectric
South Kupreanof Micro-Hydro	14862	1.5	Proposed Hydroelectric
Swan Lake	2911	22,000	Licensed Hydroelectric
Sweetheart Lake	13563	20,000	Licensed Hydroelectric
Tyee	3015	20,000	Licensed Hydroelectric
Whitman Lake	11841	4,600	Licensed Hydroelectric
Wolf Creek Boatworks	14845	300	Proposed Hydroelectric

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Project	FERC No.	Capacity (kW) [a]	Status
Southcentral			
Allison Lake	13124	6,500	Licensed Hydroelectric
Bradley Lake	8221	119,700	Licensed Hydroelectric
Chignik	620	60	Licensed Hydroelectric
Cooper Lake	2170	19,380	Licensed Hydroelectric
Dry Spruce	1432	75	Licensed Hydroelectric
Grant Lake	13212	5,000	Licensed Hydroelectric
Humpback Creek	8889	1,250	Licensed Hydroelectric
Kvichak River-Igiugig	13511	4,000	Hydrokinetic Pilot License
Nuyakuk River	14873	10,000	Proposed Hydroelectric
Old Harbor	13272	262	Licensed Hydroelectric
Power Creek	11243	6,000	Licensed Hydroelectric
Solomon Gulch	2742	12,000	Licensed Hydroelectric
Susitna-Watana	14241	600,000	Under FERC abeyance
Terror Lake	2743	36,000	Licensed Hydroelectric

[a] kilowatts

Table 5.–Summary of Alaska Clean Water Actions (ACWA) grants awarded for the 2019 to 2021 grant cycle.

Project Name	Location	Group
Reduce Bacteria Pollution – Anchorage Bowl	Anchorage	Anchorage Waterways Council
Kenai River Water Quality Monitoring and Assessment	Soldotna	Kenai Watershed Forum
Little Susitna River Total Aromatic Hydrocarbons Monitoring	Talkeetna	Aquatic Restoration and Research Institute
Ketchikan Watersheds Management	Ketchikan	Southeast Alaska Watershed Coalition
Jordan Creek Watershed Management	Juneau	Southeast Alaska Watershed Coalition
Water Chemistry Evaluation for Bristol Bay	Bristol Bay	University of Alaska Anchorage
Low-Impact Development Planning for the City of Homer	Homer	City of Homer
Lake Lucille Management Plan	Wasilla	City of Wasilla
Scaling Green Infrastructure in Fairbanks	Fairbanks	Tanana Valley Watershed Association
Controlling Urban Runoff to Cottonwood Creek, Phase 2	Wasilla	Sustainable Design Group
Kenai Beach Bacteria Monitoring and Microbial Source Tracking Assessment	Kenai	City of Kenai
Ketchikan Beaches	Ketchikan	Southeast Alaska Watershed Coalition

Table 6.–Summary of U.S. Geological Survey streamgage sites in Alaska as of September 2019.

	Number of Gaging Stations by Water Year							
Period of Record (Years)	2012	2013	2014	2015	2016	2017	2018	2019
0<1	16	17	16	14	17	18	18	19
1 to <5	146	140	142	140	133	136	135	134
5 to <10	90	94	95	95	103	104	106	106
10 to <20	117	115	115	119	118	111	112	112
20 to <50	89	96	94	94	93	98	99	100
≥50	11	12	14	15	16	18	18	18
Total	469	474	476	477	480	485	488	489
Total active in Water Year	**122**	**123**	**107**	**106**	**100**	**103**	**100**	**106**
Total active for Southeast	26	24	22	22	22	20	19	20
Total active for Southcentral	46	48	39	37	41	40	38	41
Total active for Southwest, Yukon, Northwest, and Arctic	56	51	46	47	37	43	43	46
Seasonal Gages	16	16	16	16	16	16	16	16
Number of square miles per streamgage	4,688	4,650	5,345	5,396	5,720	5,553	5,720	5,396

Source: J. Conaway, USGS Hydrologist, Anchorage, October 3, 2019; personal communication.

[a] A Water Year occurs from October 1 through September 30.